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UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 37

PARASITES AND PARASITIC DISEASES OF HORSES IN PUERTO RICO

By

H. L. VAN VOLKENBERG
Parasitologist

Issued August 1935

UNITED STATES DEPARTMENT OF AGRICULTURE
OFFICE OF EXPERIMENT STATIONS

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By H. L. Van Volkenberg, *parasitologist*

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INTRODUCTION

The subject of parasites of the horse as presented in this bulletin includes also the parasites and parasitic diseases of the mule, ass, and burro. The kinds of the common worm parasites of the horse in Puerto Rico are similar to those found in the continental United States, differing somewhat in their manifestations. The parasitic arthropods, which are mostly external parasites, vary considerably from those found in the more temperate climates. Apparently these latter are more greatly influenced by climatic and other external factors.

GENERAL CHARACTERISTICS AND EFFECTS OF PARASITES

ABUNDANCE AND LOCATION OF PARASITES

Horses are usually infested with many different kinds and very large numbers of parasites. The skin may be attacked by numerous ticks, mange mites, and certain flies. The large intestine, which is the favorite location of the internal parasites, may harbor thousands of worms. Wandering larval worms may invade practically all organs and tissues of the body.

[1] Acknowledgment is made especially of the constructive and very helpful criticism of the manuscript by Maurice C. Hall and F. C. Bishopp of the U. S. Department of Agriculture, and W. A. Hoffman of the School of Tropical Medicine, San Juan, P. R.

SYMPTOMS AND DAMAGE PRODUCED BY PARASITES

The symptoms of parasitic infestation are unthriftiness, weakness, emaciation, anemia, tucked-up flanks, rough coat, and digestive disturbances such as diarrhea and colic.

The external parasites abstract blood from the host and irritate the skin. Ectoparasites, especially the flies attacking the horse, may also act as transmitters and intermediate hosts of disease germs and parasitic worms. The internal parasites of the horse cause damage principally by abstracting blood and by mechanically injuring tissues and organs. Parasites are especially injurious to young growing animals, causing stunting and lack of development. Mature horses do not lose their susceptibility to external parasites and to many of the gastro-intestinal parasites and are frequently injured by them. The losses from parasites are represented largely by poor development, decreased capacity for work, uneconomical use of feed, and the loss of working time from indigestion and colics.

GENERAL CONTROL MEASURES FOR PARASITES

DISPOSAL OF MANURE

The eggs of many of the worm parasites of horses are passed with the manure and undergo some development on the soil. The infective eggs or larvae are usually ingested by the horse with the food and drinking water. Thus the proper disposal of manure is an essential control measure, as manure is the source of infestation of most of the common internal parasites. Fresh manure should not be spread on pastures or grass fields to be used for horses; pastures so manured will be dangerous even months later, as the larvae of many parasites are long-lived. It may be spread on areas used by other kinds of livestock without much danger, as the parasites of equines are rarely transmissible to other animals, and vice versa. Fresh manure may be spread on heavy soils which are to be plowed, as the eggs and larvae are buried and destroyed. Plowing under manure spread on light soils may be less effective as a control measure. Recent experiments made by the Zoological Division of the Bureau of Animal Industry of the United States Department of Agriculture have shown that some of the larvae of horse parasites buried under 5 inches of sandy loam migrated to the surface, while there was practically no upward movement in clay soil.[2]

An accumulation of horse manure in an open pile undergoes a spontaneous heating process in the center but remains cold on the surface. The more compact manure well below the surface may be used after a sufficient time as fertilizer on pastures or grass fields for horses with considerable safety as the parasitic material has been destroyed by the heat. However, the outer or exposed layer to a depth of 4 or 5 inches may be teeming with live parasitic ova and larvae. This portion should be separated from the remainder and handled the same as fresh manure or placed as the beginning of another pile in order to subject it to heat. Another method of handling is to turn over the outer layer of the pile every week or so and bury it under the inner material to sterilize it by heating.

[2] MOHLER, J. R. PARASITES OF HORSES. U. S. Dept. Agr., Rept. Chief Bur. Anim. Indus. 1934: 47. 1934.

A method of storage of horse manure so that the heat can be utilized to destroy all the worm eggs and larvae of parasites has been developed by the Bureau of Animal Industry. A double-walled, double-floored box made of tongue-and-groove lumber with a 4- to 6-inch space between the double parts of the walls is constructed. The space between the double parts of the walls is filled with sawdust for insulation. A well-fitting cover consisting of two thicknesses of lumber is provided to retain the heat. Parasite worm eggs and larvae are destroyed in a period of 2 weeks in horse manure stored in this manner.

MANAGEMENT OF PASTURES AND GRASS FIELDS

Heavy stocking of pastures should be avoided. Otherwise the larger amount of manure deposited on a given area results in a heavier concentration of parasite eggs and larvae, and the larger number of animals grazing on such pastures are more certain to pick up parasites. Pastures on hillsides are more desirable than on the level areas, since the rains have a cleansing action in washing down the manure and parasitic material from the hillsides. For the same reason the bottom of a slope and the lowland may be dangerous because of the higher concentration of eggs and larvae and the more abundant moisture. Bogs in pastures around springs, watering troughs, and along streams provide a favorable environment for parasites. Streams which drain land on which infested animals are maintained may carry the infection. Animals drinking water from these streams may become infested or the infective material may be deposited on grass fields or pastures if flooding occurs.

Rotation of pastures, stock rotation, and alternating pastures with field crops are all valuable control measures for parasites. The more often horses can be moved into clean pastures, the more effectively infestations will be kept down.

Besides the infestations acquired on pastures, infestations with parasites may be acquired from fresh forage fed in the stable. The feeding of fresh, wholesome, and clean grass is very important in this climate, where green roughage is available throughout the year. At present malojillo (Para) grass is probably the most common source of infestation, as it thrives best on swampy land which provides a favorable environment for the development and perpetuation of parasites. This grass, because of its habitat, cannot be protected from contamination by the usual precautions since infective material may be washed on it with every fall of rain. Malojillo grass should not be fed to either young or old horses, especially during the wet season. The green forage for horses should be obtained from well-drained fields which have not been fertilized by fresh manure and where there is no danger of contamination by drainage from adjacent land. Elephant grass, cane tops, Guatemala grass, the sorghums, and dry hay are usually safe to feed so far as parasites are concerned, if they are protected from contamination by manure after harvesting.

OTHER SANITARY MEASURES

Horses should be fed from overhead racks or mangers well raised above the ground or floor. The feeding of horses on the ground is wasteful and dangerous to the animals. The feed becomes mixed with manure and ultimately the infective larvae are ingested with the manure-soiled feed.

Concrete floors in stables are preferable to wooden or earth floors from the standpoint of sanitation. Moisture-soaked standings provide a favorable medium for the development of parasites. Manure from stables should be removed often, daily if possible. If a paddock or corral is used instead of or in connection with a stable the soil should be well drained. Feeding from the ground should be prevented by daily removal of all feed dropped from the mangers and by destroying any grass or weeds that may grow. Contamination of the drinking water with manure should be prevented by providing sanitary watering troughs. Animals should never be allowed to drink from stagnant pools. A horse stable, corral, or manure pile located in or draining into a pasture or grass field used by horses is dangerous. The fly nuisance can be reduced by storing manure and other decaying vegetable wastes in closed containers or by spreading them thinly on fields; also by using fly traps and fly sprays.

MEDICINAL TREATMENT

The control of parasites by preventive measures is not always practical or is inefficient, and treatment is usually necessary. The Bureau of Animal Industry has developed several effective treatments for the intestinal parasites of the horse.

A veterinarian is by training and experience best qualified for the task of treating animals. All of the drugs which have been demonstrated by critical tests to be effective for worms in horses are poisons, and great care must be used in their administration and in calculating the dose according to the weight and condition of the animal. The various kinds of worms require different and more or less specific treatments. A knowledge of the parasites present as indicated by microscopic examinations of the feces may be necessary to determine the drug to be used. Besides the general contraindications for the use of worm remedies, such as extreme youth or age, greatly weakened condition, or febrile conditions, there are specific contraindications for nearly all the drugs used in the treatment of equine parasites.

The safest method of administering drugs to horses is by the stomach tube. Capsules are often used but these have the disadvantage of occasionally breaking in the mouth, and the contents, if volatile or irritant, may be drawn into the windpipe and lungs and cause serious consequences.

The administration of worm remedies with the food is unsatisfactory even with drugs otherwise known to be effective for worms. Prior to the administration of drugs, animals should be fasted. The general rule in connection with treatments for parasites of the stomach and small intestine is to fast the horse for 18 to 24 hours, and with treatments for those in the large intestine to fast 36 hours. Water may be given during the period of fasting, but both food and water should be withheld from 4 to 6 hours after the administration.

The necessity for treatment is indicated by physical examination of the animal or by examination of the feces for worm eggs. Treatment should always be given before an animal becomes weak and emaciated. An animal that is in a condition of extreme debility caused by parasites may show a striking improvement after medication. However, the task of treating such an animal is difficult, and even if an animal survives the treatment and it is effective it may

never entirely recover from the effects of the parasites. It is best to adopt a program of regular treatments. For some kinds of parasites of the horse, treatment once or twice a year is sufficient. For others treatment should be given every month or two depending on the amount of the infestation.

Treatment not only renders the infested animals more serviceable, but also decreases the stable and pasture contamination by reducing the output of parasite eggs.

INTERNAL PARASITES

LARGE STOMACH WORMS

The stomach worms, *Habronema muscae*, *H. microstoma*, and *H. megastoma* (fig. 1, *A*), are slender and whitish in color. Two of these species may attain a length of nearly 1 inch, whereas the smallest is about one-half inch long. These worms may occur free in the stomach, embedded in the mucosa, attached to the wall of the stomach, or in tumors in the stomach wall.

Importance.—Infestations with these worms usually are not noticeable except for the injuries produced by the larvae which get into the skin of horses and produce a skin disease known as "summer sores." This skin disease seems to be more common among horses in the dry areas.

Life history.—The eggs which are passed with the feces are swallowed by maggots of house flies, stable flies, or other flies which breed in horse manure. The larvae develop with the maggots and complete their growth in the flies after they emerge from the pupae. Horses become infected by swallowing live or dead flies which are infested with the larvae or by swallowing the larvae which have escaped while the flies are feeding about the mouth and lips of the horse.

Symptoms and lesions.—Except for the summer sores no definite symptoms are associated with these parasites. The worms may cause injury to the stomach by their attachment and by penetrating into the wall and also by the formation of nodules which interfere with the proper functioning of this organ.

Treatment.—Carbon disulphide should be given in doses of 6 fluid drams (24 cubic centimeters) for a 1,000-pound horse or at the rate of 6 cubic centimeters for each 250 pounds of live weight. No purgative should be used with this treatment. Fats and oils should be avoided as they promote absorption of the drug and increase the toxicity of the carbon disulphide.

The treatment is more effective if this drug is preceded by 8 to 10 quarts of a 2-percent solution of sodium bicarbonate. This alkaline solution tends to remove the thick layer of tenacious mucus which normally covers the lining of the horse's stomach. This solution should be siphoned off with a stomach tube, or otherwise an interval of 20 minutes should elapse before administering the carbon disulphide.

Prevention.—Stomach-worm infestation in the horse can be controlled by any effective measures which prevent flies from breeding in horse manure. Fresh manure should be spread at once or stored in closed containers.

SUMMER SORES

Summer sores are pronounced skin lesions which seem to occur more frequently at the joints on the outer surface of the front legs,

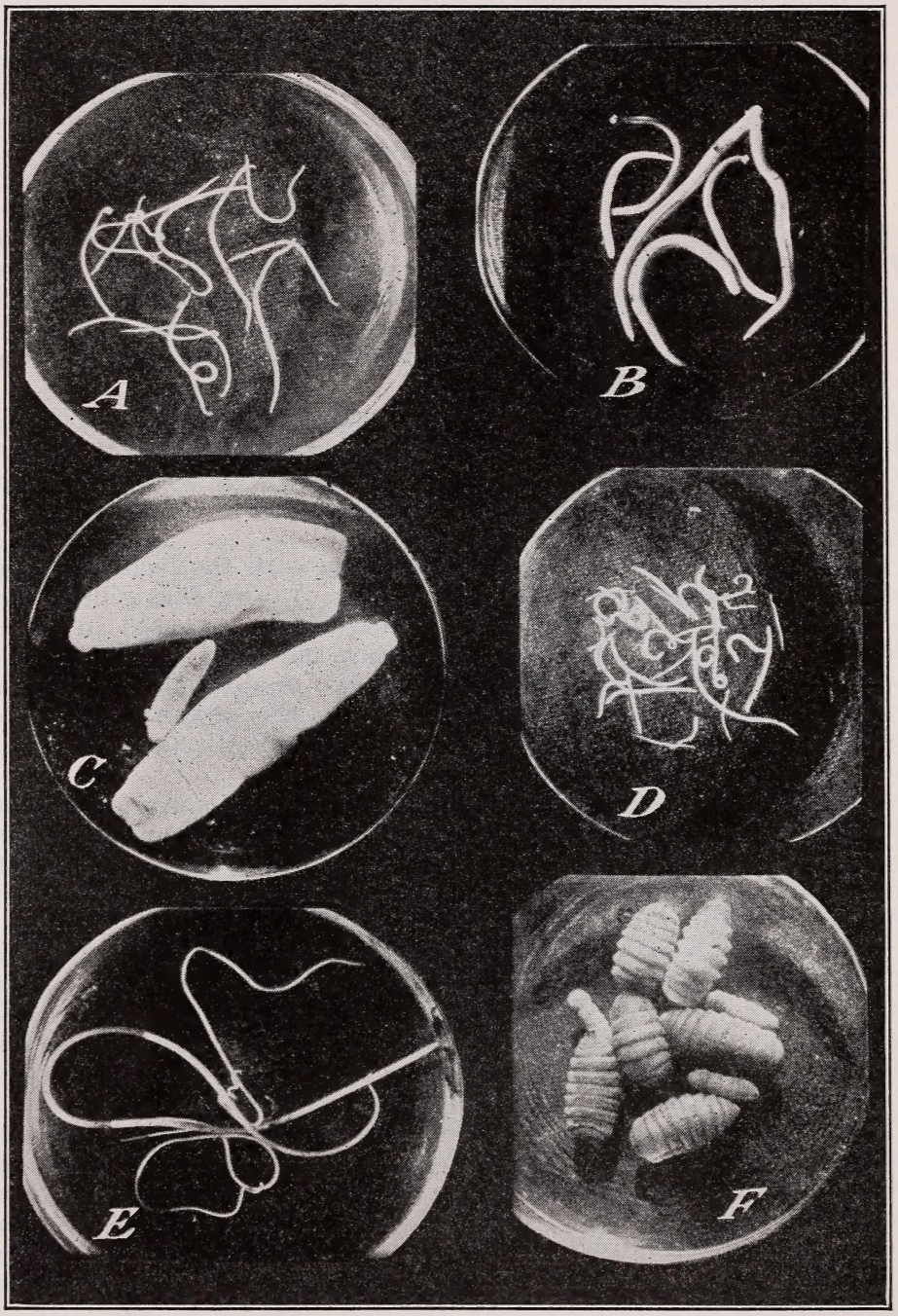

FIGURE 1.—The more common internal parasites of Puerto Rican horses (natural size): *A*, Large stomach worms; *B*, large strongyles; *C*, perfoliate tapeworms; *D*, small strongyles; *E*, threadworms of the abdominal cavity; *F*, bots of the throat botfly.

on the neck, and around the withers. The sores on the body are usually small, but on the legs they may attain a diameter of 2 inches or more. These indolent sores consist of a brownish-red pulpy

material in the midst of which are round granulations, firm in texture. In an old sore these granulations become calcified and are hard.

Apparently the larvae of the stomach worms escape from the mouth of infested flies which are feeding on wounds in the skin. These larvae remain in the wounds and cause irritation so that, instead of healing, the wound may increase in size, and a chronic lesion is produced which may persist for several months.

Treatment.—Treatments recommended for these sores are as follows: The use of a 5- to 10-percent solution of formalin, applied by means of a cotton pad which is left on the sores for 2 or 3 hours every day; or covering with an astringent powder consisting of plaster of paris, 100 parts, alum, 20 parts, naphthalene, 10 parts, and quinine, 10 parts; or washing the sores with ether or chloroform and then painting with collodion.

For the old chronic lesions, the center material may be softened by applying a caustic paste consisting of arsenious oxide, 1 or 2 parts, and flour, 5 parts. In a few days this growth will separate from the normal tissues and can be removed surgically, and a bandage and antiseptic dressing should then be applied until healing occurs.

Prevention.—Skin injuries may be protected from flies by use of pine-tar oil. Breeders of race horses who have had difficulties with this disorder are now controlling it by applying ordinary wound dressings to all wire cuts and abrasions on the skin as soon as they occur. These fresh wounds heal readily whereas the summer sores do not or are slow to respond to ordinary treatment. Incidentally the flies on these horses are being controlled by the use of kerosene-pyrethrum extract sprays.

LARGE STRONGYLES

The strongyles, located in the large intestine, include two closely related groups of roundworms which are called large and small strongyles. The large strongyles, also known as bloodworms, sclerostomes, or palisade worms, include three common species, viz, *Strongylus equinus*, *S. edentatus*, and *S. vulgaris* (fig. 1, *B*). The largest of these may reach a length of nearly 2 inches while the smallest species is from one-half to 1 inch long. These worms are bloodsuckers and feed on the blood by attaching themselves to the walls of the intestine.

Importance.—At present the large and small strongyles are the most common and widely distributed parasites of horses in Puerto Rico. Strongylidosis, caused by these worms, is probably the most serious disease of horses occurring in Puerto Rico, although it is receiving less attention than some of the other diseases.

The following statements regarding life history, symptoms and lesions, treatment, and prevention of the large strongyles are quoted from a circular of the United States Department of Agriculture.[3]

Life history.—The eggs of blood strongyles are discharged into the intestine of the host and are eliminated from the body with the feces. Under favorable conditions of temperature and moisture the eggs develop rapidly on the ground and on pastures and hatch in a day or so. The larva which emerges from each egg which develops normally, feeds on the contents of the manure in which it finds itself and after it undergoes two molts in more or less rapid succession it becomes infective. This entire development on the ground or on pasture takes

[3] SCHWARTZ, B., IMES, M., and WRIGHT, W. H. PARASITES AND PARASITIC DISEASES OF HORSES. U. S. Dept. Agr. Circ. 148; 20–24, illus. 1933. (Revised.)

place in a week or so during the warm months and is delayed considerably during the cold months. Lack of moisture is unfavorable to the developing eggs and larvae, but ordinarily there is sufficient moisture in horse feces to favor normal development, provided the temperature is favorable. Shade affords protection to the eggs and larvae and it is likely that direct sunlight is more or less injurious to them.

The infective larvae are very resistant to unfavorable conditions and are probably capable of maintaining themselves on pastures for long periods. They remain ordinarily in or near the manure where they hatch; however, they are doubtless scattered by rain and wind and may reach places on pastures relatively remote from their original locations. When the air is sufficiently moist so that the grass becomes covered with a film of moisture, as happens in times of rain, dew, or fog, the larvae migrate up the grass blades and this brings them to a favorable situation to be swallowed by horses while grazing. So far as is known, these larvae do not penetrate the skin and must infect horses by being swallowed with grass, water, or dry food which has become contaminated with the larvae.

The course of development of these parasites after they get into the body of horses has not been definitely ascertained; it is known, however, that not all larvae, and perhaps none of them, go down directly into the cecum and colon and settle there and grow to maturity. On the contrary, the larvae, after entering the body of the horse, undergo extensive migrations which bring them to various organs and tissues, such as the liver, pancreas, spleen, lungs, kidneys, and other organs and tissues, from which many of the larvae probably fail to get back to the large gut. However, those larvae which return to this organ become attached to its wall and develop to fertile maturity. The eggs which are produced by the female worms and eliminated from the horse's gut with the manure start the cycle of development once more.

From this account of the life cycle of these parasites it is evident that horses infested with blood strongyles contaminate the pastures on which they feed with the eggs produced by the worms, and that the larvae which issue from the eggs and develop to the infective stage may be swallowed by these and other horses. When horses are kept on the same pastures year after year the number of eggs and larvae gradually increases, and this contamination, accumulating from year to year on a given pasture, may be highly damaging to horses which are grazed there. Foals, in particular, suffer from the effects of gross parasitism acquired in this manner.

Symptoms and lesions.—The blood strongyles injure the wall of the gut to which they are attached. These worms suck a tuft of the inner wall of the gut into their mouth cups and abstract blood from this delicate lining. As the worms move from one place to another within the gut they expose its injured wall to the entrance of disease-producing bacteria. Bloodworms abstract blood from the finer blood vessels in the lining of the gut, and when many worms are present in a horse at the same time the loss of blood may be considerable and may lead to anemia with the usual consequences of weakness and of watery swellings (edema) in various parts of the body. These worms also produce injuries of various sorts in the parts of the body to which they wander, such as the liver, pancreas, and other organs.

One species, the single-toothed strongyle, is especially injurious because as an immature form it settles in certain arteries, especially in the anterior mesenteric artery which supplies blood to the large gut. As a result of the presence of the worms in this blood vessel, the wall of the artery, where the worms accumulate, becomes thickened and stretches considerably to form what is known as an aneurism. An aneurism is a spindle-shaped, cylindrical, or globular dilation of a blood vessel and often contains a heavy deposit of fibrin inside. In the horse it may attain the size of a child's head.

An aneurism interferes to a considerable extent with the circulation of blood through the affected artery, because the heavy deposits of fibrin inside may almost obliterate the lumen of the blood vessel. This condition results in a diminished blood supply to the large intestine; when the intestine becomes anemic as a result of this it becomes predisposed to colic, twist, and intussusception, the last being a condition in which part of the gut slips into an adjoining part. When a piece of fibrin deposit in the aneurism breaks loose, it may be carried in the circulation to a terminal portion of an artery and may lodge there as a plug. As a consequence, the circulation to a part of the large gut may be completely shut off. Such a condition interferes with the functions of the large gut, produces an anemic condition with the consequences noted above, and in extreme cases may produce death. It is believed that most cases of colic in horses result form such disturbances in the blood circulation of the gut. If the plug forms in a hind leg

it may cause a form of intermittent lameness. Aside from the injuries described, mixed parasitic infestation, known as strongylidosis, results when blood strongyles occur in large numbers and in association with other species of roundworms in the large gut, particularly when horses are kept on permanent pastures.

This condition is widespread in horses and is usually more injurious to foals and young horses than to older horses. Strongylidosis is frequently mistaken for infectious anemia or swamp fever and cases diagnosed as swamp fever, in many instances, have cleared up following the removal of worms by medicinal treatment. The common symptoms of strongylidosis are diarrhea, weakness, and emaciation. The digestive disturbances result from the irritation to the lining of the gut produced by the parasites. At first the diarrhea is slight and the soft manure has a bad odor and contains poorly digested food material; later the diarrhea becomes more pronounced, with softer feces. The appetite, which is irregular at first, becomes poorer and finally the horses are off feed. As a result of their weakened condition, affected horses find difficulty in chewing, may throw out mouthfuls of feed, and then reject feed altogether. This leads to further emaciation which becomes very marked. As the disease progresses the bones become prominent, the coat becomes rough, the eyes are sunken, and the animal becomes greatly weakened. With these symptoms there are marked changes in various tissues and organs of the body.

The working capacity of horses which are suffering from strongylidosis is decreased considerably even before the symptoms become very pronounced, and in the absence of treatment such horses are able to do less and less work as the disease progresses. It has been found that when horses are treated for the removal of parasites many of the symptoms described above disappear, the animals take on weight, regain their working capacity, and make an all-round improvement.

Treatment.—It is advisable to fast the animal 36 hours before treating for large strongyles. Oil of chenopodium is effective for their removal. This drug should be given in a dose of from 4 to 5 fluid drams (16 to 20 cubic centimeters) for a 1,000-pound animal, or at a dose rate of 1 fluid dram (1 cubic centimeter) for each 250 pounds of weight, immediately preceded or followed by 1 quart of raw linseed oil or by an aloes ball. Cases of excessive purgation have been reported in some instances following the use of raw linseed oil. It is possible that this undesirable action is due to impurities in the product; consequently a good grade of oil should be used.

A mixture, said to be without the undesirable effects of raw linseed oil, has been recommended as follows:

For weanlings, castor oil, 4 to 6 ounces, and neutral oil, 1 pint; for yearlings and 2-year-olds, castor oil, 6 to 8 ounces, and neutral oil, 1 pint; for 3-year-olds and older, castor oil, 8 to 10 ounces, and neutral oil, 1½ pints.

Carbon tetrachloride is also of value for the removal of large strongyles. It should be used in treating pregnant mares as oil of chenopodium is dangerous for such animals. It may be given in doses of 6 to 12 fluid drams (25 to 50 cubic centimeters) for a 1,000-pound animal.

Normal butylidene chloride is another drug that is effective for the removal of large strongyles. It should be given in a dose of 3 fluid ounces (90 cubic centimeters) for a 1,000-pound animal, and followed in 5 hours by raw linseed oil at the rate of 1 quart per 1,000 pounds of weight. It is probable that the dose of normal butylidene chloride could be reduced to 2.5 ounces (75 cubic centimeters) for a 1,000-pound animal, without materially reducing the efficacy of the drug.

One treatment with any drug will not always remove all worms present and, if necessary, treatment may be repeated in from 4 to 6 weeks.

Prevention.—Preventive measures designed to control strongyles consist (1) in rotation of pastures, so far as possible, avoiding low and wet pastures, and (2) sanitation of stables to prevent larvae from developing to the infective stage and from contaminating the feed and water. This is accomplished by daily removal of manure from stables, supplying the feed in boxes and racks well raised above the floor, and supplying clean water. The disposal of stable manure is an important preventive measure. * * * Little can be accomplished in the way of pasture sanitation except on farms where thoroughbred or other valuable horses

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are raised. On these farms the removal of manure deposits from pastures may be practiced, as this procedure will remove almost all the parasite material before it can develop and spread. Such a procedure is necessarily troublesome and expensive and can be undertaken only by breeders to whom the question of expense is of secondary importance. The average breeder will have to resort to simpler and less radical measures, such as avoiding the overstocking of pastures, frequent rotation of pastures, and special attention to foals. Where overstocking and the use of wet pastures are unavoidable, and rotation is impossible, reliance must be placed on treatment as often as necessary for control.

Horse breeders, and even the general farmer, should pay considerable attention to the sanitation of paddocks in which the newly born foals are kept. The foals should be kept there for several weeks before they are put on pasture. The removal of manure from the paddocks, at least once a week, will cut down the supply of eggs and larvae to which the foals would otherwise be exposed. This precaution will help to tide the foals over the most critical period of their lives.

Young animals of all sorts are special cases and require special care. In the last analysis the saving of young livestock involves the same precautions which are used in connection with the prevention of sickness in children. Above everything else, a wholesome food supply and clean surroundings are the best safeguards against disease. Special precautions to prevent foals from becoming parasitized are essential parts of sound management in horse-breeding establishments and on the average farm.

SMALL STRONGYLES

The small strongyles (fig. 1, *D*), including the cylicostomes, consist of several groups of worms and many different species. Whereas the large strongyles are red, the small strongyles are usually white or grayish white in color. These worms are either attached to the walls or are found free in the contents of the caecum and colon. They do not feed, at least ordinarily, on the blood, but they may feed on the mucosa or lining of the intestine. Many of these worms are very small, while others of the many species are as large or nearly as large as the smaller palisade worms. The large strongyles may occur in infestations of a few hundred worms while the small strongyles may number thousands in the same animal. The immature forms of some of these worms occur in nodules in the walls of the large intestine. One species produces rather severe ulcers on the walls of the colon.

The frequent obstipations or so-called colics among horses and mules, which occur at certain seasons each year both in St. Croix of the Virgin Islands and in Puerto Rico, seem to be caused by abrupt and massive invasions of the larvae of the small strongyles, either alone or associated with the large strongyles. These larvae passing through the intestinal walls into the organs and tissues of the abdomen in numbers, injure these tissues and may carry with them pathogenic organisms. Acute strongylidosis or infestation with the larval phase of the strongyles are terms that may be used to describe this condition. It has been demonstrated both in Puerto Rico and in St. Croix that these epizootics of colic can be prevented by following the recommendations given for the control of parasites.

Treatment.—The same anthelmintics are used for both the large and small strongyles. Carbon tetrachloride is less effective than either oil of chenopodium or normal butylidene chloride.

Prevention.—The same control measures should be used for both the large and small strongyles. Preventive measures are more necessary during the 2 or 3 months immediately following the torrential showers. In the southern coastal section precautions should be used during the entire rainy season.

The most important recommendations for the prevention of strongyle colic in horses and mules are: (1) Do not feed forage on

the ground; (2) do not spread horse manure on grass fields or pastures, and prevent the drainage of yards, stables, and manure piles into pastures or grass fields used by horses; (3) feed only wholesome grasses selected from the higher and better drained fields; (4) avoid low, wet pastures; (5) treat horses as often as necessary for parasites.

PERFOLIATE TAPEWORM

The tapeworm *Anoplocephala perfoliata* (fig. 1, *C*) is found in the caecum and also in the lower portion of the small intestine. This is a white, flat segmented worm from 1 to 3 inches long.

Life history.—The ripe or gravid end segments which contain the eggs become detached from the rest of the chain and are expelled from the body with the manure. The further development and manner of infestation is unknown.

Importance.—Very heavy infestations have been found in horses and mules in the district of San Sebastian. In the vicinity of Mayaguez and on the southern coast infestations among horses seem to be uncommon.

Symptoms and lesions.—Heavy infestations may cause intestinal catarrh, digestive disturbances, emaciation, and anemia. This worm is said to cause ruptures of the intestinal walls. Ulcers on the walls of the intestine are produced at the points of attachment of these worms.

Treatment.—Critical tests to determine effective treatments for tapeworms in the horse have not been performed. The following drugs have been recommended: Oil of turpentine, areca nut, kamala, and oleoresin of male fern.

Oil of turpentine is given in a dose of 2 fluid ounces (60 cubic centimeters) in capsules and followed every second day by 1 ounce until 5 or 6 doses have been given. One quart of raw linseed oil is given with the last dose.

Areca nut, freshly ground, may be given to adult horses in doses of from 1 to 1.5 ounces (30 to 45 grams) in capsules after fasting the animal 24 to 36 hours. If the bowels do not move within 4 or 5 hours, it is advisable to administer 1 to 2 pints of raw linseed oil.

Kamala is given in doses of 1 ounce (30 grams) after fasting for from 24 to 36 hours. A purgative is not usually necessary with this drug.

The dose for oleoresin of male fern is 3 to 6 drams (10 to 20 grams) with a fasting period of 24 hours. It should be followed immediately by 1 quart of raw linseed oil.

All of these drugs should be used with caution. They should be given only to animals presumably able to withstand any poisonous effects of the drugs.

Prevention.—As the life history is unknown, no recommendations other than the proper disposal of manure can be recommended.

OTHER INTERNAL PARASITES

The large intestinal roundworm or ascarid, *Ascaris equorum*, is found in the upper part of the small intestine. This worm may equal or exceed an ordinary lead pencil in size. Ascarids are more common and cause more damage among foals and young horses. This worm is occasionally found, usually as small, immature specimens, in adult horses in Puerto Rico, but its incidence among colts is not known.

Because of its large size, the toxic secretions produced by it, and the wandering habits of the larvae, it has the capacity for causing considerable damage, and heavy infestations may cause illness and even death. Unthriftiness in foals that is not a result of poor feeding or poor breeding may be caused by ascarids, and microscopic examination of the feces for the worm eggs should be made in such cases. Carbon disulphide (p. 5) is an effective remedy for the removal of ascarids. The dose of this drug should be carefully judged and measured according to the size and age of the animal to be treated.

The small stomach worm, *Trichostrongylus axei*, occurs in the lining of the stomach. It is only about one-fifth of an inch in length. It causes small tumors, thickening of the stomach wall, and other injuries to the stomach by embedding in the lining. These worms are removed to some extent by the same treatment as that for the large stomach worms.

The pinworm, *Oxyuris equi*, inhabits the large intestine. It is from 3 to 6 inches in length, with a long thin tail. Yellowish crusts consisting of masses of eggs may be seen around the anus of infested horses. Usually the only symptom noticed is the irritation produced by presence of the worms in the region of the anus and by some irritant property of the eggs, which cause the horse to rub the tail and hind parts against any convenient object. Apparently these worms are of little importance in this climate.

Oil of chenopodium as recommended for the large strongyles is an effective drug. Oil of turpentine in a dose of 2 ounces (60 cubic centimeters) for a 1,000-pound animal is also effective. Both the oil of chenopodium and the oil of turpentine should be preceded or followed immediately by 1 quart of raw linseed oil or by the proper dose of the mixture of castor oil and neutral oil, as given under the treatment for large strongyles (p. 9).

The lungworms, *Dictyocaulus arnfieldi*, are long, slender, whitish worms found in the bronchi and bronchioles. They are from 1 to 2 inches in length. So far as known, lungworms are not a serious pest of Puerto Rican horses. It is doubtful if medicinal treatment is of any value against lungworms. Nursing treatment and prevention are the most feasible measures that can be recommended for lungworms.

A bot, *Gastrophilus nasalis* (fig. 1, *F*) is found in the stomach and small intestine. This bot is the larva or maggot of a fly, which is known as the throat botfly or chin fly. Apparently this fly is the only one of several common species of botflies of the horse that has been able to establish itself under climatic conditions such as exist in Puerto Rico.

The ova of the chin fly are deposited by the fly on the hairs under the jaw of the horse. The oviposition period in Puerto Rico has not been determined. These ova hatch and the young bots crawl to and enter the mouth. Eventually they pass down and attach themselves to the lining near the exit of the stomach and also in the upper part of the small intestine. They remain here for 8 to 12 months undergoing development, and finally pass out with the manure and pupate on the ground. These bots are often found on necropsy but so far always in very light infestations. The throat botfly has the reputation of being very annoying to horses while depositing its eggs but trouble from this source has not been noticeable, probably due

to the scarcity of the fly. However, this fly will probably increase in abundance. Because of the large mouth hooks used for attachment and the spines which project from the body, bots may cause irritation and injury to the stomach and small intestine if present in large numbers.

Carbon disulphide (p. 5) is the most effective drug for the removal of the bots. Judging from the size of the bots found on necropsy the drug should be administered during January or February.

The threadworm, *Setaria equina* (fig. 1, *E*), is a white, slender worm from 2 to 5 inches long. It is found in various locations outside the alimentary canal but usually occurs free in the abdominal cavity. A few of these worms are usually found on autopsy. These worms in the abdominal cavity do not appear to cause any damage and are not known to produce any symptoms. If an immature worm gets into the eye, which apparently occurs only rarely, it may be removed surgically under local anesthesia.

The neck threadworm, *Onchocerca cervicalis*, is a long, slender worm found in the large neck ligament. Sand flies (*Culicoides*) have been shown to carry these worms. This worm apparently irritates the tissues and thus lowers their resistance to disease germs, and may lead to the development of poll evil and fistulous withers. This worm seems to be scarce and this infestation and also disease of the withers and poll are uncommon among local horses. No treatment for the destruction of the worms is known.

The liver fluke, "lingua" or "cucaracha", *Fasciola hepatica*, which is a common parasite in cattle and goats and to a less extent in swine, is also found in the horse. Apparently the horse is not very susceptible to this worm as infestations are uncommon. Carbon tetrachloride as given for the large strongyles should be effective for the destruction of these flukes.

EXTERNAL PARASITES

THE TROPICAL HORSE TICK

The tropical horse tick, *Dermacentor nitens* (fig. 2), which is the common tick on horses in Puerto Rico, is reddish brown in color and without any markings. This tick prefers the inside of the ears as a place for attachment. Colonies are found also in protected areas such as the mane, tail, around and below the anus, and under the jaw. Long-haired horses, especially foals, may have the entire body infested with these ticks. Occasionally colonies of young ticks are found on the eyelids.

Importance.—These ticks are widely distributed over the island but infestations seem to be more severe among horses of the mountain regions and in the dry sections. The environment seems to be less favorable for the tick in the wet coastal areas. These ticks are causing considerable injury to horses and very little is being done to control them.

Life history.—According to the Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, the life history may be summarized as follows: The engorged female drops from the animal to the ground where it may deposit from a few hundred up to 3,000 eggs. The eggs hatch in 24 days or longer. After attachment the tick may become mature within 26 days. The entire life cycle may be completed within 8 weeks.

Symptoms and lesions.—The tick causes injury by drawing blood from the host and by irritating the sensitive ears. The female of this tick during engorgement excretes a substance which, when dry, resembles coagulated blood. The ears may be filled with crusts of

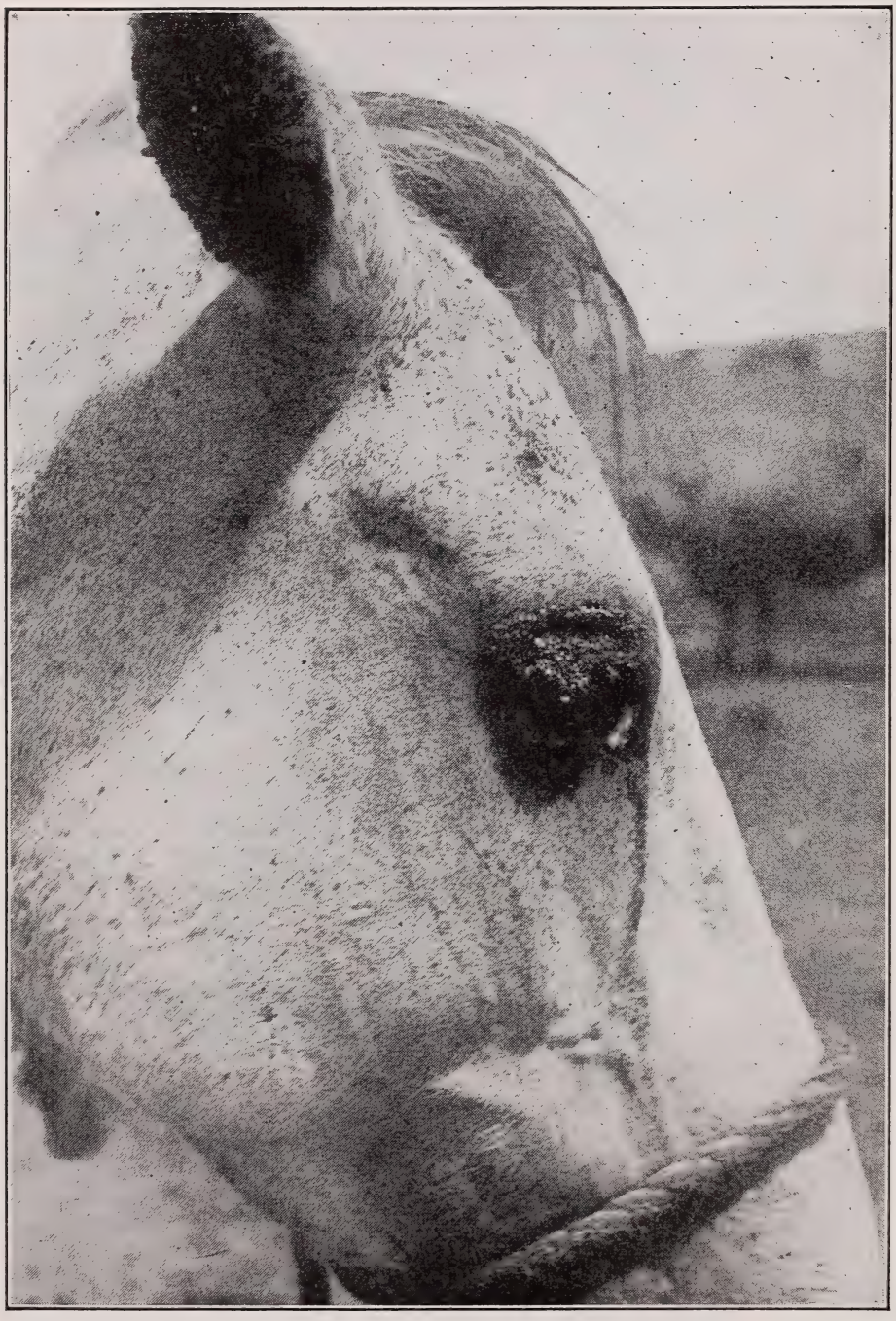

FIGURE 2.—The tropical horse tick infesting ear and eyelids.

this excreta, and the hair, especially about the head, becomes matted with a mass of material. The filth in the ear may result in suppuration. In the dry sections this excreta is less noticeable since it dries and scales off as it forms.

Treatment.—The arsenical solutions as used for the common cattle tick are effective for killing this tick and may be applied to the body as dips or sprays, but should not be used as local applications inside the ears.

First clean the ears with a wire loop, being careful not to injure the animal, and then inject into the canal of each ear about one-half ounce of a mixture consisting of 2 parts commercial pine tar and 1 part cottonseed oil. A mixture of 1 part kerosene and 3 parts lard is also effective. The first mentioned mixture has the advantage of protecting the ears from reinfection for a month or more.

Prevention.—Keeping horses from an infested pasture for 4 months is said to be sufficient to insure the starvation of the seed ticks on the pasture.

PSOROPTIC MANGE, SARNA, OR PIOJILLO

The mite, *Psoroptes equi*, which causes psoroptic mange, lives on the surface of the skin (fig. 3). This is a very small mite, barely visible to the naked eye if placed on a dark background.

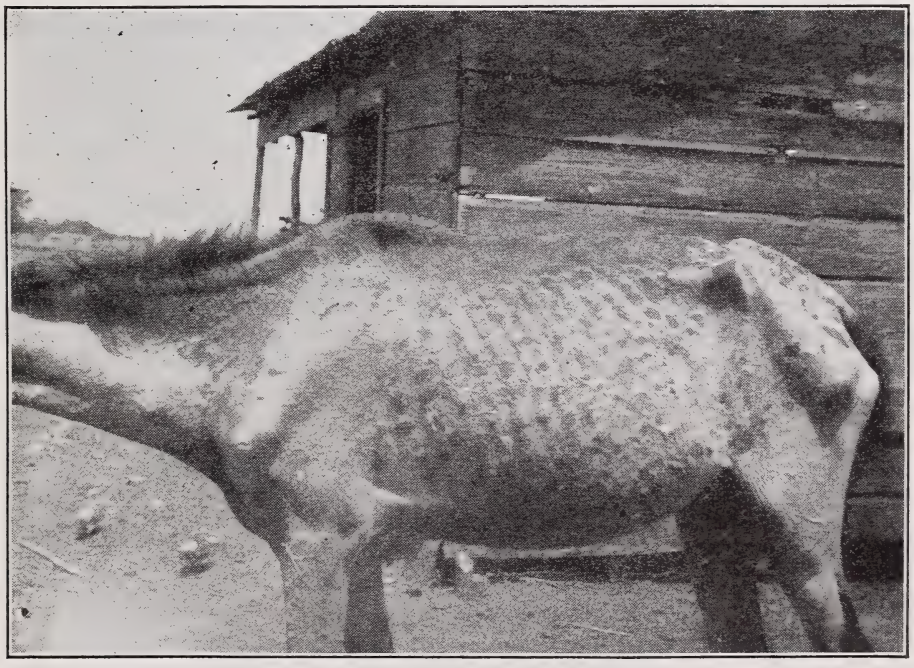

FIGURE 3.—A well-advanced case of psoroptic mange.

Importance.—Infestations are common, but usually do not cause a serious disease in this climate. The more serious infestations have been found in the more closely confined horses used as draft animals in the towns. In the country districts very little is being done to control this mange except among the larger herds of horses.

Symptoms and lesions.—This mange mite prefers the more protected parts of the body. Usually the first lesions are noticed on the head and neck near the mane or at the base of the tail. From here mange spreads slowly to other parts of the body. The lesions on the body are usually localized in spots or areas which may gradually increase in size. The mites biting or pricking the skin cause a slight inflammation and intense itching. The animals bite and rub themselves to

relieve this itching. Later scales or scabs are formed and there is a loss of hair. Finally the skin becomes thickened and hard and thrown into wrinkles or folds. Among pastured animals this last stage of swelling and tumefaction of the skin may be long delayed. A horse which is in the open throughout the year may harbor the infestation for several years, and the only lesions which will be noticed by the casual observer are a loss of hair in spots and a slight thickening of the skin. Sometimes these hairless spots are found over the entire body, including the legs.

Treatment.—The most effective proparations for mange are lime-sulphur or nicotine dips which are applied as a spray or by dipping in a tank. Proprietary brands of these preparations, usually with directions for dilution on each container, are available. The coal-tar creosote disinfectants sold under various trade names are also effective. These should be mixed or diluted with soft water in order not to injure the animal. Two applications of any of these preparations, from 10 to 12 days apart, usually cure ordinary cases. Four or more applications may be necessary for chronic cases.

Unprocessed crude petroleum or crank-case drainings will cure mange if applied before the disease becomes chronic. These are usually applied to the infested areas of the skin at intervals of one week. However, these oils cause a loss of hair and often blister the skin. As an added precaution, animals should be kept in the stable or otherwise protected from the direct rays of the sun as long as the oil remains on the skin.

Prevention.—As this mange is very contagious to all classes of horses, it is important that mangy horses be isolated and all equipment kept separate until the disease is eradicated. It is a good sanitary practice to clean and disinfect all stables and small enclosures which have been occupied by mangy horses, also all harnesses and other objects used on horses, before using them for clean animals.

SARCOPTIC MANGE

The mite, *Sarcoptes equi*, which causes sarcoptic mange, is slightly smaller than the psoroptic mite. This mite penetrates the skin and excavates or burrows through the upper layer of the skin. It is more serious than the psoroptic mange mite as it causes more irritation to the skin and is more difficult to eradicate. However, sarcoptic mange is an uncommon disease among horses in Puerto Rico.

As psoroptic mange and sarcoptic mange may be confused with each other, examinations should be made for the mites. This is done by scraping the skin of an infested area until the blood oozes and then examining the scrapings under a microscope.

The treatment is the same as given for psoroptic mange, but it requires persistent, thorough, and frequent applications of the preparations recommended. From 4 to 6 dippings, 5 to 7 days apart, may effect a cure in ordinary cases, especially if all the affected areas are soaked with warm dip and scrubbed with a brush just prior to the first dipping. Animals which have been neglected until the affected skin has become greatly thickened and leatherlike are usually incurable.

BITING OR BLOODSUCKING FLIES

All the more common biting flies found on the Continent of North America are represented in Puerto Rico by the same or similar species. However, none of these is as serious for the horse as those occurring in parts of the continental United States, although two or more species are common and injurious during certain seasons of the year.

The stable fly, *Stomoxys calcitrans*, resembles somewhat the common house fly, but it has a long slender proboscis projecting down and forward from the head and not terminating in the enlargement present in the house fly. The stable fly is widely distributed over the island and occurs throughout the year. As in the case of many other flies, both insufficient moisture and excessive moisture are unfavorable to its increasing in numbers, so that it is usually more abundant following a period of rains. Probably the stable fly causes more injury than any of the other flies attacking the horse in Puerto Rico.

The horn fly or la mosca del ganado, *Haematobia irritans*, prefers cattle as a host but frequently attacks horses. This fly is about one-half the size of the house fly and can be identified by its habit of feeding with the head down, in line with the hairs of the body and with its wings spread. The horn fly is found in the coastal areas, and occurs in great abundance at different times during the summer in the dry southern coastal area. Usually the horn fly does not attack the horse in swarms as it does cattle.

The deer fly or ear fly, *Chrysops variegatus*, is a long slender fly with a yellowish color. Distinguishing features of this fly are the conspicuous black eyes and the broad smoky bands in the wings. This fly usually attacks the horse on the head about the ears. It is a vicious biter but it is not so numerous as to be a noticeable pest to horses. This fly is more common following the rainy season and is usually found in the low wet coastal areas. It prefers heavily shaded areas as resting places and horses located in or near these places are more subject to attack.

Four species of the large black horseflies, *Tabanus* spp., have been reported. These flies are capable of causing considerable injury to horses because the long piercing mouth parts of the female produce a painful wound. Specimens are hard to find on the horse or in the field. Because of their scarcity these flies are usually unfamiliar to stockmen.

Various species of mosquitoes attack animals, especially horses. Small swellings caused by the bites of mosquitoes are often noticed on tender-skinned horses. A few stockmen consider the mosquito an important pest of the horse.

The black flies or majes, *Simulium* spp., of which there are at least three species in Puerto Rico, are more abundant in the higher elevations near streams. As these flies are carried by the wind, swarms of them may be found in other localities. These flies are a serious pest in many places, killing numbers of animals, but because of lack of abundance they are not considered of much importance.

The sand flies, or plagas, of which *Culicoides furens* is the most important member, are very abundant in the vicinity of the seashore. As these flies are carried by the wind they are often found farther inland. These bloodsucking midges are very annoying to man, but

horses do not seem to be greatly disturbed even in the presence of a swarm of them.

Treatment.—For the prevention of stable fly and horn fly breeding, all collections of manure, straw, old hay, and other vegetable material about the stable should be cleaned up and spread immediately or stored in enclosed boxes or pits. For mosquitoes, destroying the breeding places by drainage or treatment with oil or paris green or by impounding water and using certain species of small fish which eat the wrigglers are always important control measures. Detailed information, including preventive measures, concerning several of these flies is available in publications issued by the Bureau of Entomology and Plant Quarantine, United States Department of Agriculture.[4]

OTHER EXTERNAL PARASITES

The screwworm, or el gusano de la herida, *Cochliomyia hominovorax* (Syn., *C. americana*), is the maggot of a blowfly which is found in wounds of animals. Recent investigations made by the Bureau of Entomology and Plant Quarantine indicate that this fly is a primary invader of wounds, while another fly, *C. macellaria*, difficult to distinguish from this species, is a secondary invader and also breeds in carcasses.

The screwworm usually attacks cattle and swine but also occurs in the horse. The maggots of this blowfly are dangerous in that they are capable of penetrating practically sound tissues. There are several other species of blowflies but the maggots are located usually in old infected wounds or those already infested with screwworms.

The eggs of the screwworm fly deposited in a wound hatch and the larvae or maggots burrow into the wound, grow rapidly, and complete their development in 4 or 6 days. The other blowflies have a similar life history. Because of the eating away of the tissues there is serious danger from hemorrhage and also from infection. Attacks by screwworms may occur at any season of the year, but are more frequent immediately following the rainy season.

For treatment of screwworms pour benzol or very small amounts of chloroform into the infested wound, remove the easily accessible maggots, and then apply pine-tar oil. Removing the deeply embedded maggots or probing or opening the burrows is not recommended. All fresh wounds of animals should be coated with pine-tar oil to prevent fly blow.

The chigger, *Trombicula tropica*, which is a very small red larva of a mite, attacks horses and other livestock. This mite is common in the coastal areas during and immediately following the wet season. Its attacks on the horse are especially noticeable about the face and head. Because of the rubbing from the intense itching produced by attachment and feeding of these larvae, the hair may be rubbed off the face. Dusting sulphur on the skin or applying it in an ointment is an effective control measure.

The gnats or mimes, *Hippelates* spp., of which there are several species, are very abundant especially in dry localities. These very

[4] BISHOPP, F. C. THE STABLE FLY: HOW TO PREVENT ITS ANNOYANCE AND ITS LOSSES TO LIVESTOCK. U. S. Dept. Agr. Farmers' Bull. 1097, 18 pp., illus. 1931. (Revised.)
HOWARD L. O. and BISHOPP, F. C. MOSQUITO REMEDIES AND PREVENTIVES. U. S. Dept. Agr. Farmers' Bull. 1570, 11 pp. 1932. (Revised.)
BISHOPP, F. C. THE CONTROL OF FLIES ON DAIRY CATTLE AND AROUND DAIRY BUILDINGS. U. S. Dept. Agr., Bur. Ent. E267, 3 pp. [1928.] [Mimeographed.]
——— BLACK FLIES OR BUFFALO GNATS. U. S. Dept. Agr., Bur. Ent. E321, 2 pp. 1934. [Mimeographed.]

small flies do not bite but if abundant they cause some annoyance to horses and other livestock by constant humming, swarming about the body, and darting into the eyes, ears, and nostrils. They can be controlled by using the kerosene-pyrethrum extract sprays. As the flies are attracted to sores on the skin all abrasions and wounds should be coated with pine-tar oil.

Both bloodsucking and biting lice occur on the horse. Lice occur more frequently among horses in the temperate climates and are serious only during cold weather when the hair is long. In the climate of Puerto Rico they seem to be rare. If present, they probably occur in such small numbers that they do not cause annoyance and are not easily detected. Several verbal reports of the finding of lice on horses have been received, but specimens have not been obtained for identification of the variety or species. The treatment for lice is to apply either an arsenical solution as used for the cattle tick or one of the coal-tar preparations, following the directions given on the container. To eradicate lice it is necessary to give two dippings at an interval of from 14 to 16 days, as one application will not kill all the eggs.

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